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The Practice of Meteorological Observation 80 years ago.

By H. E. CARTER

Early climatological records of the Scottish Meteorological Society show interesting differences from present day methods of observation. This note is devoted chiefly to these differences, but the relative continuity, in essentials, with present day practice, shows that the earliest nationally organized observations were made on carefully considered lines. The fact that an Edinburgh publication of 1796 contains a specimen monthly register strongly reminiscent of M.O. Form 3203 confirms that a much earlier experience was available.*

Observations for a large number of stations commenced in 1856 but the earliest regular records on printed schedules preserved in the Meteorological Office, Edinburgh, are those for the year 1857. They are written—mostly in handwriting which excites admiration—on large forms, about 23 in. by 18 in. One side contains a month's observations and spaces are provided at the bottom of the sheet for the preparation of summaries in a form not very different from that adopted at official climatological stations to-day. On the reverse side are entered phenological observations such as dates of flowering of trees and shrubs and the appearance of migratory birds; and also details of crops under the headings "Dates of sowing," "Appearing above ground," "In ear or flower," and "First cut."

From instructions printed on the forms, it seems that the observer was allowed considerable latitude in regard to the time of observation: "The Society recommends a quarter before nine o'clock, morning and evening, as the most convenient hour; but should this be inconvenient for the observer, another hour may be chosen, attending

* F. E. Dixon, *Met. Mag.* Nov. 1937, p. 239.

however, to the rule that morning and evening readings be taken at the same hour." As to the barometer, we are told that "it ought always to be gently tapped before taking the reading." For methods of reduction etc. reference is made to the "Report of the Committee of the Royal Society on Physics and Meteorology," 1840. In regard to thermometers, it is stated that "the maximum registering thermometer, for taking the extreme heat of the sun's rays, should have its bulb blackened and the surface rendered dull" and the grass minimum thermometer "should have its bulb similarly blackened and rendered dull." "Different contrivances" are mentioned for housing the thermometers. The well known Stevenson Screen was not introduced until some years later, 1864, but its forerunner seems to have been "a double meat-safe ventilated box with louvre-boarded sides." Again—"As Fleming's* Rain Gauges seem to possess several advantages over others, the Society gives the preference to them; but whatever form be employed, in order that all the stations may give comparable results, it is recommended that the gauge be sunk in the ground so that the top of the receiver is nearly on a level with the top blades of close cut grass." (In 1859 Glaisher set up the gauge of his own design at Hartwell, Bucks, with the rim 6 inches above ground.†) There is evidence of some concern on the question of dating; one observer mentions that his observations are for the "24 hours previous to 9.30 a.m." while another tells us that he reads his raingauge at midnight, a striking example of devotion to the science.

The Beaufort Scale of wind force does not seem to have come into general use at Scottish land stations until 1905 though a modified Beaufort Scale was used at Ben Nevis in 1883. At lighthouses the Beaufort Scale was in use in 1868 and probably much earlier. In 1796 a scale of 0 to 4 had been recommended. In the monthly forms for 1857 it was "generally agreed to reckon the force of the wind from 0 to 6, the latter being the severest hurricane in this island." Decimals were used in the lower ranges of this scale. By 1859 the use of Lind's Anemometer was recommended for obtaining the greatest force of the wind during the period of observation, the estimation by scale being "to say the least, unsatisfactory." After another two years the Council of the Society strongly recommended "that every observer be furnished with a Hemispherical Cup Anemometer, a self-registering instrument which shows the amount of wind that passes it per day; from which also the velocity of the wind at the time of observation may be ascertained." The observer was left to fill in the unit used for force or speed and several observers give values in pounds per square foot.

Cloud amounts are given according to the present day scale, 0 — 10. There is an interesting reference to the possible effect

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* A 3 inch float gauge. See *British Rainfall*, 1868, p. 22.

† *Speculum Hartwellianum*, 1860.

of the full moon on clouds : " As the full moon, so long as it is above the horizon, is thought by some eminent astronomers to have a powerful effect in dispelling clouds, it would be well to note in the general observations any facts bearing on this point for a few days (or nights, as the case may be) before and after every full moon ; and the same observation ought to be made at the periods of new moon." The amount of sunshine was represented in 1857 in fractional form, the denominator indicating the possible duration and the numerator the number of hours the sun shone. This form of expression did not last long and in 1859 a single number represented " the number of hours the sun shines." Two years later (1861) the observer was instructed to enter " the number of hours objects in the sun's rays cast shadows." This latter change suggests that even in those days a tendency to over-estimation was in existence and this is confirmed by the frequency of entries of 16, 17 and even 18 hours sunshine a day, in the summer months at Northern stations.

The observer of 1857 was encouraged to make observations of ground temperature at depths of 3 and 12 inches " to ascertain the temperature of what may be termed the agricultural soil." In 1859 a third ground temperature, at 22 inches, was added. Provision was made for entering the temperatures of springs or deep wells, and, at coastal stations, of sea temperature and density. Some stations gave observations of ozone and also of electricity. The electrometer used for the latter observation is thus described : " pith balls suspended by a silk thread, in connection with a metallic conductor, and under cover, the degrees of a circle being used to express the degree of repulsion." The effects of weather on the life of the people, the harvest, the health of cattle, shipping, etc. come in for more frequent comment than is nowadays the case. Judging by a remark of the minister at Bressay (Shetland) the weather of January 1859 was at least as severe as in some recent winters. He describes it as " the most changeable and violent of any corresponding month ever remembered in this district ; constant gales of wind and violent rain almost continually." Local pride is evident in a note by a minister in the far north, who, in referring to one of the Society's reports, says : " I am gratified to find that the climate of Orkney has attracted the notice it deserves." There is a preponderance of " twopenny blues " among the postage stamps on these forms, that representing the charge for postage in those days. The observer was warned in a footnote that no wax or wafers were to be employed in closing the schedule for posting.

A footnote to the schedules in 1861 reads " Returns from the ' Principal Towns ' should be in Edinburgh not later than the 2nd." —a reference to the towns whose records were utilized then, as now, in the monthly tables prepared for the reports of the Registrar General for Scotland.

One wonders whether these early co-operators in an organized system of recording meteorological data ever visualized that more than 80 years later officials would be consulting their original records in connection with questions of public importance.

Duststorms in India

By R. G. Veryard.

The prediction of duststorms is an important and by no means easy part of the routine work of an aviation forecaster in India. It is not sufficient to warn aircraft that conditions will be favourable for duststorms; a pilot wishes to know the time and duration of the duststorm, the strength of the winds associated therewith, and, if possible, the width, depth and vertical extent of the dust curtain. With a limited amount of data at his disposal, the forecaster cannot hope to give all this information accurately, particularly as the formation of duststorms is still imperfectly understood; important questions have still to be answered. With increased research, however, a more detailed knowledge about these phenomena is being obtained. In the article under review Sreenivasaiah and Sur of the India Meteorological Department describe their investigation into the thermodynamics of duststorms*.

The authors commence with the statement that a duststorm is not essentially different from a thunderstorm except that the former is associated with less precipitation. A distinction is made, quite rightly, between a duststorm and a mere dust-raising wind; at a place like Peshawar the latter is often a föhn wind. The writer's own experience is that duststorms may have the character of thunderstorms due, perhaps, to local instability in which case the width of the dust curtain is limited to about 20 miles or less; or that the storms may be associated with fronts, in which case the dust curtain may extend in a line for 100 or even 200 miles. Some duststorms are accompanied, preceded or followed by thunder, rain or even hail; some occur with an almost cloudless sky; and by no means are all the thunderstorms of the Indian hot weather accompanied by duststorms. It is interesting to note that Farquharson (1) considers that haboobs, the duststorms of the Sudan, are associated with thunder-squalls. On the other hand, Sutton (2) suggested that they might be frontal phenomena although in a later paper (3) his views are more in keeping with those of Farquharson. Many years ago, Hankin (4) classified the storms into (a) *primary*, in which the dust is raised locally, and (b) *derived*, in which the dust

* Sreenivasaiah, B. N. and Sur, N.K. The thermodynamics of duststorms. *Curr. Sci., Bangalore*, 6, 1937, pp. 209–212.

has been brought from a distance. In the case of some of the duststorms in America and Australia it has also been shown that the dust has been carried along for hundreds of miles. It is certain, therefore, that all duststorms are not simply " local " phenomena. This means that one cannot rely entirely upon local upper air soundings for the prediction of duststorms but must consider the possibility of a change of air mass. Actually in the paper by Sur and Sreenivasaiah instances are referred to when duststorms were associated with the passage of a front. (Even local thunderstorms, of course, are often accompanied by a local or minor front.)

Regarding the meteorological conditions associated with a duststorm, the authors state that a marked sudden drop in temperature is one of the usual features. The writer would like to mention here that it is by no means rare for a duststorm at Peshawar to be accompanied at first by a slight rise of temperature and a marked drop in humidity, the fall in temperature occurring subsequently. These conditions are attributable presumably to the descent of air—accentuated perhaps by the travel of air over the hills—occurring at the first front of a " double " cold front. European meteorologists are familiar with this type of cold front, the explanation of which has been given by J. Bjerknes (5).

The diurnal and monthly frequencies of duststorms which the authors have computed for Agra resemble closely the frequencies which the writer worked out for Peshawar, although the total number is actually greater at the latter station. At both places—in fact over north-west India generally—the monthly frequency curves show two maxima. The first occurs in the hot dry transition season preceding the onset of the south-west monsoon, when the track of the western disturbances has receded northwards beyond the plains of northern India ; the supply of moisture is then limited and, except with the passage of feeble occlusions or an early incursion of monsoon air, there is little cloud. The secondary maximum, which is much smaller than the first, occurs in the transition season following the retreat of the south-west monsoon ; the western disturbances do not normally re-appear, even in Kashmir, until mid-November or later and there is rather less cloud than in the first transition period. Yet, during the monsoon period when there is plenty of moisture available and when conditions might be expected to be more unstable, duststorms are comparatively rare. Also, although duststorms are more frequent in the afternoons, they may occur at any time of the day and are by no means uncommon at night. In fact, as the authors point out, although insolation plays an important part in the production of duststorms, there is no doubt that these phenomena are often attributable to the passage of a front. It is hoped that in the fuller account of their investigations into the causes of and conditions associated with duststorms the authors will produce some examples of frontal analysis.

It is readily understood that these storms are associated with the existence of a state of latent instability in the atmosphere and that some sort of trigger action may be required to start them off. When, however, the authors go so far as to select an isolated occasion which they call a " typical instance of the analysis " and proceed to state that a particle having been forced to rise from the ground into the environment of latent instability would, at a specified height, acquire a speed of 35–40 m.p.h. one looks for the proof. Evidently the authors have made their calculations in accordance with the method given by Normand (6). Dr. Normand, however, makes it clear that his computations are based on certain assumptions—he ignores, for example, the effect of friction—and states that the method simply gives the order of magnitude of the velocity developed.

In view of the great heights to which the dust is lifted in a duststorm it would be interesting to evaluate the coefficient of eddy diffusion. Whilst stationed in India, the writer made an attempt to determine experimentally the degree of turbulence and the amount of dust in the atmosphere during duststorms at Peshawar but only a few rather unsatisfactory observations could be made before returning to England. In his paper on dust-raising winds Normand (7) derives the following equation relating the density of the dust to the degree of turbulence in the air :—

$$\frac{dm}{dt} = k\frac{d^2m}{dz^2} + v\frac{dm}{dz}$$

where m = the number of dust particles in a unit volume at height z above the surface

k = coefficient of eddy diffusion.

v = limiting velocity of fall of the dust particles.

Treating, as a first approximation, k and v as constants independent of z one obtains for a " steady " state, i.e. $dm/dt = 0$,

$$k \log m + vz = \text{constant} = k \log m_0$$

where m_0 is the value of m at $z = 0$

Hence $\log\frac{m_0}{m} = \frac{vz}{k}$ or $m = m_0 e^{-vz/k}$

Since particles of different sizes have different rates of fall it is necessary to apply the above equation separately for given sizes. Hence, if the steady state is reached approximately, and if the concentration at ground-level of particles of sizes 1, 2, 3, are m_0^1, m_0^2, m_0^3......respectively, then one would expect the concentrations of the different sizes at height z to be $m_0^1 e^{-v_1z/k}$, $m_0^2 e^{-v_2z/k}$,......etc.

It occurred to the writer that it would be most interesting to obtain values of m_0^1, m_0^2, m_0^3......etc., at ground level and of m^1_z, m^2_z, m^3_z etc. for various values of z. One could then theorize legitimately because observations of the distribution of dust would be available to check one's theories.

It was intended therefore to get a good set of observations, for various heights, of (*a*) the total weight of dust per unit volume of air and (*b*) fractional weights or numbers of different sizes of particles. It was expected that the assortment of particles at each height would be according to the normal frequency curve. The abscissae could be chosen to represent concentrations (or weights per unit volume) of each range of size of particle so that the area of the whole curve would represent total weight of dust per unit volume. It was hoped to pass from a frequency curve of weights to a frequency curve of numbers of particles or from a curve of numbers to a curve of weights, by calculation, after checking by sample experiments the assumption made in making the calculation.

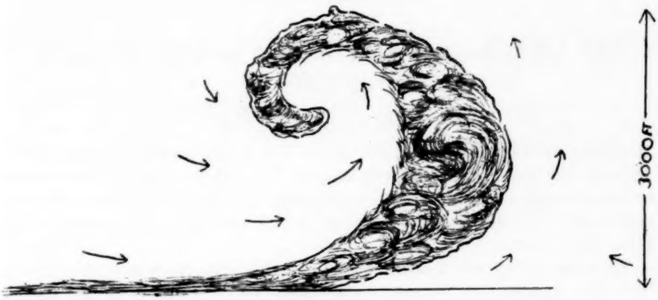


FIG. 1.—SIDE VIEW SKETCH OF DUST-STORM.

A special dust-weigher designed by the Instruments section of the India Meteorological Department was used and the R.A.F. wireless tower at Peshawar, fitted with a number of platforms, enabled the writer to obtain readings at various heights. It was assumed that counting the particles of a fair sample by weight and the adoption of a mean weight per particle would be sufficiently accurate to give the number of particles in the total quantity collected. Unfortunately samples taken from the same collection of dust gave widely different results. Actually, the size of the particles was found (by means of a microscope) to vary mainly between 10^{-4}cm. radius to 10^{-1} cm. radius and the number from several thousands per c.c. to a few millions per c.c.—about 50 per cent. being of the order 10^{-2} cm. For various reasons it was possible to make observations in only five duststorms at heights ranging from ground level to 50 feet. In all cases the dust reached much greater heights—in one instance to over 2,000 feet as observed from the air. Although the task is neither a pleasant nor an easy one, it is hoped that some enthusiastic meteorologist will carry out the investigation attempted by the

writer—but with more success. A side view sketch of a duststorm made by the writer is given in Fig. 1. Arrows indicate the probable air motion. The fine sketches of duststorms made many years ago by Baddeley (8) are also worthy of note.

REFERENCES.

(1) London, Quart. J.R. met Soc., 63, 1937, pp. 393–414.
(2) London, Quart. J.R. met. Soc., 57, 1931, pp. 143–58.
(3) Cairo, Phys. Dept. Pap., No. 27, 1930.
(4) Calcutta, Indian met. Mem., 22, Pt. VI, 1921.
(5) London, Geophys. Mem., 5, No. 50, 1930.
(6) London, Quart. J.R. met. Soc., 64, 1938, pp. 47–66.
(7) Calcutta, Indian met. Mem., 22, Pt. VII, 1921.
(8) Baddeley, P. F. H, Whirlwinds and dust-storms of India. London, 1860.

The Distribution of Pressure and the Drought of 1938

By C. E. P. Brooks, D.Sc.

In *The Times* for May 14th Mr. A. A. Lea refers to the high pressure area in the north-eastern Atlantic and adjoining coasts which was the immediate cause of the spring drought and asked if meteorologists could say why depressions were kept at a distance from the British Isles for so long.

In attempting an answer to Mr. Lea's question it is necessary first to consider the normal distribution of pressure over the North Atlantic, the Arctic Ocean and the neighbouring parts of Europe and Siberia and then to examine the differences from this normal distribution during the early months of 1938.

The normal pressure distribution in winter and spring in the wider neighbourhood of the British Isles is governed by three main " centres of action," namely, an anticyclone over the Azores, an anticyclone over Siberia and a low pressure area in the neighbourhood of Iceland. The two anticyclones are fairly stable but the Icelandic low represents the focal point of a continuous series of depressions travelling from a westerly to an easterly point. Pressure normally rises from Iceland towards the Arctic Ocean and the main track of the depressions lies near 60° N. latitude.

The Arctic Ocean carries a mass of floating ice which under the normal light and irregular winds of that region is spread over almost the whole ocean. This forms a cold surface above which the air is cold and stable.

Over the British Isles the isobars run roughly from WSW. to ENE. but they are constantly disturbed by secondary depressions and fronts associated with depressions near Iceland and occasionally by primary depressions following a more southerly track. These disturbances bring our usually abundant rainfall.

The type of disturbance of these normal conditions which most commonly leads to drought over the British Isles can be simply described as a shift of the whole system towards the north-east. The Azores anticyclone advances towards the British Isles giving high pressure and fine anticyclonic weather, while at the same time the tracks of the depressions follow unusually high latitudes. This implies that the southern boundary of the cold stable air mass over the Arctic Ocean in the region of Europe and western Siberia also lies unusually far north. Since the cold air mass is to some extent a product of the floating ice, we should expect the southern boundary of the Arctic ice also to lie unusually far north.

Floating ice is driven by winds and currents but a large and relatively flat sheet requires prolonged winds from one direction to set it in motion. The maps of pressure, and of deviation of pressure from normal, drawn for the northern hemisphere each month in the Meteorological Office, based on the "Climat" messages* broadcast early in the following month, show that throughout January, February and March, 1938, the pressure distribution over Europe, Siberia and the Arctic was such that abnormally persistent southerly winds prevailed on the north coast of Europe and western Asia. This southerly current of air drove the ice northward, with the result that high temperature and low pressure prevailed over the Arctic during February, March and April. High pressure and drought over the British Isles during these months was the natural corollary.

We still have to account for the southerly winds in the Arctic, and this, at present, we are unable to do. Conditions in any area in any month follow in a highly complicated way from preceding conditions over a large part if not the whole world, while changes in the sun and terrestrial "accidents" such as volcanic eruptions may also play a part. At present the problem presented by these relationships is very far from being solved, and it is possible only to give a very partial answer to Mr. Lea's question.

Royal Meteorological Society

A meeting of the Society was held on Wednesday, May 18th, in the Society's rooms at 49, Cromwell Road, South Kensington. Dr. B. A. Keen, F.R.S., President, was in the Chair.

The following papers were read and discussed.

R. Moss.—Atmospheric optical phenomena in North East Land.

A record is given of the various atmospheric optical phenomena observed during the ten months' occupation of a station on the inland ice of North East Land (80° N., 20° E.) by the Oxford

* See *Meteorological Magazine*, 72, 1937, p. 105.

University Arctic Expedition, 1935–36. As well as the more common mock suns and mock moons several complexes were observed, notably on June 6, 1936, when the comparatively rare Parry arc occurred. There were also many instances of a phenomenon which has occasionally been described previously but which has not been distinguished from others, with which it usually occurs simultaneously. It takes the form of a pair of *white* mock suns on or near the visible horizon: they do not appear to be essentially connected with the usual "prismatic" halo phenomena. The name "hypohelia" is proposed for them.

Miss M. M. Paranjpe, Ph.D.—The variations of the solar constant and their relation to weather.

The determinations of the solar constant obtained by the Astrophysical Observatory of the Smithsonian Institute during the last thirty years are discussed, with results which point to the conclusion that the observed variations are mainly due to the defects in the methods of determining the solar constant. If this conclusion is accepted the subsequent work based on the supposed variability of the solar constant is not valid.

A. F. Crossley, M.A.—Notes on the variation of pressure accompanying a distortion of air flow.

It is known that certain meteorological stations frequently record a mean-sea-level pressure which is lower than that which would be expected from the general run of the isobars by amounts up to about one millibar. These stations are located in over-exposed situations, such as the tip of a promontory, where the wind speed may be appreciably in excess of the speed in an ideal exposure. In steady motion, the flow of wind over or round the promontory conforms with Bernoulli's equation, which gives a relation between pressure and velocity at points on the same stream line. It is shown that a reasonable increase of wind speed above normal produces a decrease of pressure of the right magnitude. The equation is applied in the first instance to steady frictionless motion, but it is shown that the results apply with little variation to the flow of surface air, as modified by friction.

T. E. W. Schumann, M.Sc., Ph.D., and W. L. Hofmeyr, M.Sc.—The partition of a region into rainfall districts with special reference to South Africa.

A method is presented for dividing any region into a number of rainfall districts on the basis of seasonal distribution of precipitation. This is accomplished by drawing on a map of the region two systems of lines of equal "phase" and equal "relative amplitude," which are measures respectively of the epoch of maximum rainfall and of the normal fluctuation which occurs in the course of a year. A map of the Union of South Africa is reproduced showing rainfall districts obtained by this method.

Correspondence

To the Editor, *Meteorological Magazine*

Divergent Winds

It is good to have Dr. Sutcliffe's reminder of the difference between "divergence" and "fanning out" of winds and isobars but experience certainly suggests a high correlation between the two phenomena and a further note from Dr. Sutcliffe explaining any possible reason for this would be very welcome. It would be useful to know, too, whether the correlation is sufficiently close to justify the assumption in practical forecasting, on occasions when reports of upper air temperatures and winds are scarce, that fanning out is normally accompanied by subsidence.

Just as it is frequently necessary to assume that the 2,000 ft. wind is equal to the gradient wind, so the most accurate forecasts may result from the assumption that fanning out indicates subsidence and the wiping out of cloud and frontal effects.

R. M. Poulter

Meteorological Office, R.A.E., S. Farnborough, Hants., April 7th, 1938.

A further remark on Divergent Winds

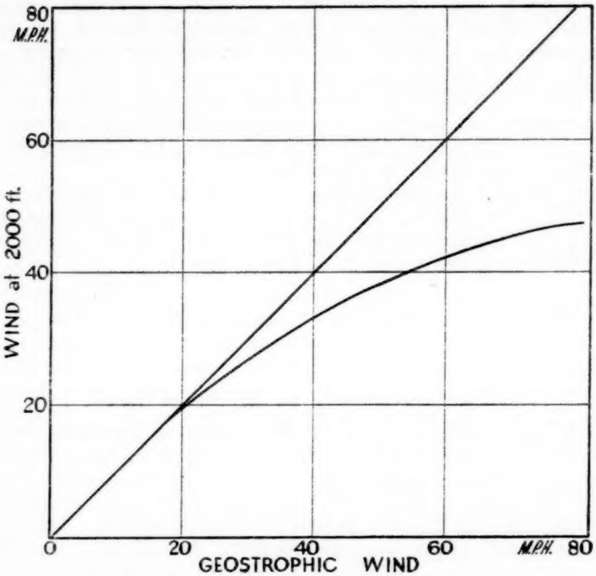
In the note of similar title in the March issue of the *Meteorological Magazine* it is remarked that "The winds are of course never more than approximately geostrophic and it is the departure from the geostrophic value which determines all divergence. . . . . The effect of spreading isobars upon the geostrophic departure is not difficult to determine with certain approximations.". This is true. Upon the approximations used will depend, apparently, not only the quantitative, but also the qualitative, value of the result. I have investigated the effect of fanning isobars and find, assuming an unchanging pressure distribution and gradient winds, that the convergence of the air depends entirely upon the quantity $\nabla\left(\frac{1}{rd}\right)$ where r is the radius of curvature of the path of the air (i.e. of the isobars), regarded as positive for cyclonic motion, and d is the distance apart of the isobars.

If we regard r as constant we obtain the result that, with fanning isobars (that is isobars spreading out in the direction of the flow) there will be divergence with cyclonic motion, convergence with anticyclonic motion.

In the particular case in point the curvature of the isobars appears to be cyclonic over most of the British Isles, and hence we should expect there to be divergence. The extent to which this result will be affected by changes of curvature is not easy to estimate, but

since r appears to decrease the amount of divergence will be reduced. It is generally found, however, in actual trajectories, that the curvature remains practically constant.

This theoretical discussion gives a result seemingly in accordance with observations, but there is a second, more practical, way of looking at the problem.



The figure shows the result of comparing, for a great number of winds from between S. and W., the actual wind at 2,000 ft., as found by pilot balloons, and the geostrophic wind as measured from a working chart. It was found that, as is already well known, the actual wind was, almost without exception, less than the geostrophic wind; the graph shows that the difference between the two is greater, even proportionately, for high speeds than for low.

Accepting this fact then it is clear that a fanning of the isobars would, in fact, give rise to divergent winds.

Quantitatively, under the conditions illustrated in Fig. 1 of the leading article of the December, 1937, issue of this magazine the divergence is of small order. In either of the above theories the divergence is such that, if reversed to become convergence, it would give rainfall at the rate of, very roughly, 0·001 mm. per hour.

The article referred to gives no clue as to where, if anywhere, the pleasant weather was particularly evident. Nor does a cursory

glance through the *Monthly Weather Reports* do more in this direction than cause one to express mild surprise that a period of six months of which one is reported to have had a " marked deficiency " of sunshine, two to have had a " general deficiency", two to have been " average " and one only to have " exceeded the average", could be described as a period of " pleasant weather".

RONALD FRITH

Meteorological Office, R.A.F., Hemswell, Lincs., March 29th, 1938.

[Dr. Frith starts a new hare in the last paragraph of his letter. I will only remark that in defining pleasant weather dryness and warmth surely count for as much as sunshine, and June to October, 1937, were very dry in England and warm on the whole. The passage criticised, however, referred to the weather generally characteristic of the type of pressure distribution illustrated, of which 1937 was admittedly not so good an example as say 1921 or 1933. The favourable conditions are best developed in southern England and neighbouring parts of the continent, and it seems hard to escape from the logical conclusion that there is a certain amount of subsidence in this district. C. E. P. BROOKS.]

The Aurora of May 11th—12th, 1938

An auroral display was observed from here between 23h. 40m. and 23h. 55m. G.M.T. last night (May 11th). From a point to the SE. and at an elevation of 80°, brilliant white streamers radiated to the sector of the horizon between north and north-east; one streamer from the north-east continued right across the sky to the south-west. Between the streamers the sky glowed rosy pink and this was actually the first phenomenon observed. The time between the first appearance and the final disappearance of the streamers was only 8 minutes, after which the pink glow slowly faded. The remarkable feature of the display was that the whole illumination was confined to the sector of the sky between north and north-east, with the exception of the streamer from north-east to south-west, passing west of the moon. There was about seven-tenths of cirrus at the time. G. THORNTON SMITH

Meteorological Office, R.A.F., Hucknall, Notts., May 12th, 1938.

I am sending a short description of the Aurora which I saw round about 1h. this morning.

At about 0h. 55m. I first observed two bright carmine patches of haze in the sky. The smaller seemed to be over Leith Hill Tower. The larger, high overhead, had a whitish green extension towards the north-west and developed long parallel whitish streaks across the red. After about four minutes the Leith Hill patch and the streaks had faded, and a red glow spread in one large hazy cloud effect directly overhead. This seemed now to be much nearer the

ground. Later, another patch appeared over towards Peaslake. This condition continued till about 1h. 5m. when I ceased to observe the phenomenon. I noticed a pronounced "electric feeling", as before a thunderstorm.

MILDRED SLOW.

Abinger Hill School, near Dorking, Surrey, May 11th, 1938.

The following notes on the aurora have been forwarded by Mr. J. H. Dyson of Preston, Canterbury:—

Auroral activity first suspected at 2330 B.S.T., when a belt of pale radiance, faintly luminous, was discernible to the north at approx. 30° elevation.

2330–0000:—Steady increase of activity.

0000 B.S.T. (approx.):—General brightening of the display, with splashes of white light low to NNW.: formation of low, flat arch, NW. to NNE., of approx. 30° elevation, with a few, faint rays.

0026–0034:—Rays and streamers, rather faint, elevation 30°–40°N. Pale luminosity NW.–NE. Above arch, sky faintly tinged with rose: arch becoming curved, increased to 35°–40° NNW.

0034–0040:—Elevation of arch 40° NNW. Increased activity to NNW. and NNE., with pale rays and streamers: sky at 60° pale rose purple, especially to NNE.

0040–0042:—Increased activity: becoming brilliant. Bright rays NW.–NE., and crowned by deep, blood-red tint.

0042–0046:—Brilliant Aurora. Blood-red at 80°, W. across to NE., flaming at intervals. Equal to Jan. 25th–26th.

0046–0056:—Brilliant "flame" aurora moving slowly from WNW., of blazing carmine, elevation 90°: multi-coloured rays: superb display W. to ENE., with bright rays extending to zenith: southern half of sky tinged by reflection with peculiar green of weathered copper.

0056–0101:—Blood-red W.–NE., extending to zenith.

0101–0113:—Display fading: general rose pink above 30° elevation, and pale copper green below. A few rays.

0113–0115:—Pink fading out: a few pale streamers to NW. and N.

0115–0119 and after:—A few pale streamers moving from N. to NW. at 20° elevation: red coloration faded out, except for a tint of rose at N. 40°.

A Green Moon.

In the November issue of the *Meteorological Magazine*, Dr. F. J. W. Whipple wrote about the phenomenon of a "green moon." In Inverleith Park on Wednesday, November 24th, at 8h. 15m. a similar moon was visible at an elevation of about 35°. The moon was twenty-one days old, the last quarter being on the 25th. At 7h. the sky was cloudless and the visibility was 7. The sun rose

at 7h. 34m., and at 8h. 15m. a small cirro-cumulus-lenticularis and some alto-cumulus had developed. The moon was covered by a thick cloud, as on October 16th, which I think was alto-cumulus.

It seems that since the conditions of atmosphere were quite normal, the explanation which Dr. Whipple gives for this phenomenon adapts itself equally well to both observations, that is, that it was the result of a contrast. The illumination of the sun on the clouds round the moon had produced this odd effect, such that the pure white moon seemed green. On October 16th the phenomenon was observed about twenty minutes after sunset, and on November 24th it was observed about forty minutes after sunrise. But the elevation of the moon was different and may cancel out the difference in time. And perhaps the effect of the risen sun's illumination on clouds at an elevation of 35° is similar to that of a set sun on clouds at 20°.

Unfortunately, I was unable owing to hurry to observe the subsequent changes in colour through which the moon passed, but the facts which I have given may be of interest to others who have observed this phenomenon. FERGUS MACPHERSON.

7, Wardie Crescent, Edinburgh, December 11th, 1937.

Snow Notes for Winter, 1937—38

In view of the increased interest now being taken in the snow conditions of the British Isles perhaps the following notes may not come amiss. The state of things described must not be taken as normal for the mildness and absence of precipitation in the second half of the winter is without precedent. Observations were noted at three stations, viz. at 2,300 ft. on ridge of the Black mountains separating Hereford from Brecon, 12 miles distant; at 1,300 ft. just over the Monmouth border, 2 miles distant, and in a valley here 200 ft. above sea level.

In October and November there was no snow lying at any station; in December there was snow lying at 2,300 ft. on 20 days (and including patches, 30 days); at 1,300 ft. on 9 days; in valley on 3 days, or rather parts of days, and never as much as ½ inch deep, which snow fell on 5 days. In January at 2,300 ft. on 6 days (and including drifts left from December on about 13 days), at 1,300 ft. on 1 day and in valley no days. Snow fell 1 day. In February at 2,300 ft. on 3 days (no drifts); at 1,300 ft. on 2 days, in valley no days, snow fell on 3 days. Since February 18th there has not been a speck of snow even at 2,600 ft. and precipitation for the month was only 0·74 (of which about 0·10 was snow at 2,300 ft.). March was the driest March on record, the rainfall being only ·025 (·005, ·01 and ·01), while April up to 21st has only provided 0·05. Ben Nevis, which in mid-April should have a covering of 10 ft. of snow, has only a few patches on the summit. In the 51 days March 1st–April 20th we have only had 0·08 rain and the anticyclone shows no signs of collapsing. Is it possible that sun spots—I saw 5 large ones a few

days ago—have upset the normal circulation of the atmosphere and have caused this extraordinary persistence of anticyclonic conditions over Britain ?

The late R. P. DANSEY.

Kentchurch Rectory, Nr. Hereford, April 21st, 1938.

NOTES AND QUERIES

Observations at the Radcliffe Meteorological Station, Oxford, in the years 1931-1935.

An article entitled " The Swan Song of the Radcliffe Observatory," published in the *Meteorological Magazine* for September, 1932, contained an appreciation of the five-yearly volumes of observations published by the Trustees of the Radcliffe Observatory. In particular, praise was bestowed upon the Appendix to the last volume (1926-1930) in which was given a homogeneous set of serial monthly values for each element going back to the earliest date for which comparable data were available. In the case of dry bulb temperature and rainfall the observations went back to 1815. When the article was written it was feared that, with the removal of the Radcliffe Observatory from Oxford, the publication *in extenso* of the meteorological results would cease, although strenuous efforts were being made to provide for the continuance of climatological observations in Oxford. In these circumstances it is a very great pleasure to record the publication of a volume entitled " Results of Meteorological Observations made at the Radcliffe Meteorological Station, Oxford, in the five years 1931-1935." We learn from the Introduction that the station remained under the control of the Radcliffe Observer, Dr. H. Knox Shaw, until June 1935. In 1935 the Radcliffe Trustees presented all their meteorological instruments to the University of Oxford and in addition undertook to pay the salary of a full-time observer. The Observatory buildings have become the Nuffield Institute of Medical Research but the Nuffield Trustees have allowed the meteorological instruments to remain in nearly the same positions as they occupied in previous years. The enclosure containing the earth thermometers and the Stevenson screens which house the thermometers and the thermograph was moved on January 1, 1935 to a position 60 ft. SSW. of the old position. It now stands in the middle of the lawn as is shown in the photograph on the title page of the volume ; the old position was on the edge of the same lawn a few yards to the west of the main porch of the Observatory buildings. The enclosure was widened to 18 feet and now contains, in addition to the Stevenson screens and the earth thermometers, the grass minimum thermometers and the rain-gauges. The University has delegated the

control for administrative purposes to its School of Geography with Mr. W. G. Kendrew in charge. It is most satisfactory that so long a series of meteorological observations can go on unbroken.

The tables in the new volume differ in some respects from those in the previous publications. In order to reduce expense certain columns have been omitted from the daily values, namely, the 9h. values of dry and wet bulb temperatures, the velocity of the wind, the cloud amount, the visibility and also the daily weather notes. With these omissions two months can be arranged on one page and the book is considerably thinner than the last volume of the Radcliffe Observatory. These observations are still made and the results kept in the manuscript records of the station. Another small difference is that the daily values of the underground temperature and the notes on occasional phenomena are grouped together for the five years instead of being placed at the end of the corresponding year. Near the end of the volume is a section giving the summary of monthly values for each element in continuation of similar figures in the Appendix to " Results of meteorological observations made at the Radcliffe Observatory, Oxford, in the five years 1926–1930." A useful new table giving the mean monthly underground temperatures at 1 foot and 4 feet at 9h. for the years 1925–1935 has been added to this summary.

Some interesting records were established in the five-year period 1931–35. The month December, 1934, was particularly interesting ; the mean pressure 29·354 in. is the lowest on record for December, while both the mean maximum and mean minimum temperatures, 50·8°F. and 42·7°F., are the highest on record. The absolute maximum temperature in August 1932, namely, 95·2°F. is the highest temperature that has been recorded in any month, while May 1932 is distinguished as being the dullest as well as the wettest May on record.

In the final section new tables of period means are given for pressure, number of rain-days, sunshine, wind velocity and wind direction.

L. F. LEWIS.

" WIXFW "

An article entitled " WIXFW " by C. F. Brooks in the *Harvard Alumni Bulletin*, July 2nd, 1937, describes progress made during the preceding two years in upper air observations by radio sondes.

Early in 1937 a series of ascents was made to test the reliability for routine soundings of the radio-meteorograph developed at Harvard. Of 31 ascents, 27 gave records up to 17,000 ft. or more, the average being 44,000 ft. The best was a record of all elements (pressure, temperature and humidity) up to 79,000 ft.

The method by which the values of the elements are signalled is as follows :—

A small cylinder of electrically insulating material is turned by

clockwork at 1 revolution in half a minute. On the cylinder is wound a helix of four turns of platinum wire. Four light styles make contact at different parts of the helix once in each revolution. One of the styles is fixed, the other three being carried by the meteorological instruments, aneroid, bimetallic thermometer and hair hygrograph. As the values of the elements change the styles move parallel to the axis of the cylinder, so that the contacts occur at varying time intervals after those of the fixed style. Each contact sends out a signal, which is amplified by the receiver and recorded by a marker which moves across a sheet of paper. The dots form curves, one for each of the three elements; the distance of each curve from the straight base line, interpreted by a calibration curve, is a measure of the element.

The meteorograph costs about 18 dollars, and the total cost of an ascent is less than 25 dollars. Even if the instrument is lost every time, this is less than the cost of an aeroplane ascent to a height comparable with that reached by the meteorograph.

D. N. Harrison.

REVIEWS

Hurricanes, their nature and history. Particularly those of the West Indies and Southern Coasts of the United States. By Ivan Ray Tannehill. Size 9 in. × $6\frac{1}{4}$ in., pp. x + 257. *Illus.* Princeton, Univ. Press and London, Oxford Univ. Press, 1938. Price 3·50 dollars net.: 16s. net.

In connection with the establishment of hurricane warning stations by the U.S. Weather Bureau in the West Indies during the Spanish-American war, the author of this book quotes President McKinley as saying that he was more afraid of a West Indian hurricane than of the entire Spanish navy. In earlier wars hurricanes have scattered and sunk navies and troop ships, while in times of peace the total losses amount to many thousands of lives and uncounted material wealth. The Chief of the Marine Division of the U.S. Weather Bureau is therefore writing of a subject of great human and economic importance, and as he is able to draw freely on his own long experience and the vast storehouse of information at his command, he has produced a notable contribution to meteorological literature.

The opening half of the book is mainly descriptive. The first chapter deals with the structure of the hurricane, and is illustrated by reproductions of autographic records showing the "eye" and some remarkable descriptions of this central calm and of the violent winds which surround it. Then follows a very good account of the accompanying great storm waves which have been responsible for some appalling catastrophes, and constitute the greatest danger to life in coastal towns of the hurricane regions.

The origin of hurricanes has been a matter of some controversy between the adherents of the older convectional and the newer

frontal theory. It is generally difficult to obtain sufficient observations during the early stages of a storm, but the author is able to discuss in considerable detail one which originated in the Caribbean in 1926, and he shows that instead of growing from a small whirl it developed gradually over a considerable area. In a very detailed account of tracks in different months, and in a later chapter on unusual hurricane movements, he is able to show how both normal and aberrant tracks can to some extent be accounted for by considerations of land and sea distribution and by neighbouring pressure systems.

Chapters V and VI deal with the heavy rainfall of tropical cyclones and barometric pressures in the centre. Several readings below 27 inches are known, but there is some doubt about most of these, though the figure of 26·185 inches quoted from the *Meteorological Magazine* for February 1933 appears to be accurate. The signs of an approaching hurricane are next described, especially storm swells, which are explained in detail. The descriptive part ends with chapters on the destructive effects of hurricanes, illustrated by some very striking photographs, and precautionary measures.

The second half of the book is historical. The final chapter gives a chronological list of several hundred West Indian hurricanes from 1494 to 1900, with brief remarks, and many of these are described in greater detail, particularly as regards damage and loss of life, in preceding chapters. Information about the earlier hurricanes is naturally scanty, but more or less accurate mapping of tracks becomes possible for storms towards the close of the 19th century, the first tracks illustrated here being those of three historical storms in 1790. With the twentieth century the documentation becomes much more complete, and from 1901 onwards the hurricanes are described and illustrated year by year. Of the 919 listed in the book, no fewer than 249 came in the years 1901 to 1937. The historical part of the book deals only with West Indian hurricanes; it forms a most valuable addition to the meteorological literature of the North Atlantic. The work ends with a comprehensive bibliography. The whole is excellently produced and abundantly illustrated, and there is a good index. C. E. P. Brooks.

Climatic Notes: New Zealand Districts. By Dr. E. Kidson. Meteorological Office Note No. 17. pp. 1–32. Wellington, 1937.

This paper forms No. 17 of a series of notes dealing with different aspects of the climate and weather of New Zealand, which have been published since 1931 by the Meteorological Office in Wellington. The present note has been prepared primarily for use by agriculturists in connection with soil-surveys. The paper is in two parts in both of which the same general arrangement is followed. The first part deals with the climate of Hawke's Bay and the second with that of North Auckland.

The elements discussed include temperature, frost, rainfall, humidity, sunshine and wind. Except in the case of rainfall the data available are somewhat scanty and are limited to observations from not more than six stations in each district and for some elements from only two. For rainfall the information is much more detailed. Charts are reproduced of the mean annual fall and of the number of rain-days and these are supplemented by tables of the average monthly fall at more than 80 stations, for the majority of which the average number of rain-days per month is also included.

Tables indicating the variability of the rainfall are a valuable feature of the paper. They show first the extreme monthly falls at some 60 stations for which long records are available, secondly the percentage frequency of monthly falls between different limits at stations grouped together according to their annual rainfall, and thirdly a table of the rainfall in each year expressed as a percentage of the normal. The practice of indicating the variability in this way might well be followed by meteorologists more widely than it is; a knowledge of the extremes to which the rainfall is liable is all-important for an agriculturist.

BOOKS RECEIVED

Squalls at Karachi. By P. R. Krishna Rao. India Met. Dept. Sc. Notes VII, 75. Delhi, 1938.

Onweders, optische verschijnselen, Enz. in Nederland. Naar vrijwillige waarnemingen in 1935. Deel LVI. De Bilt 1937.

Ergebnisse Aerologischer Beobachtungen 25, 1936 and *Jaarboek, A. Meteorologie B. Aardmagnetisme* 1936. K. Ned. Meteor. Inst. (Nos. 106A, 97 and 98). De Bilt, 1937.

OBITUARY

We regret to learn of the death in Buenos Aires on 10th January at the age of 68 of Mr. George O. Wiggin formerly Director (1915–1924) of the Oficina Meteorológica Argentina.

Mr. Wiggin took an active part as chief assistant to Mr. W. G. Davis (Director 1885–1915) in the great development in the above service at the beginning of the century.

We regret to learn of the death of the Rev. R. P. Dansey, of Kentchurch Rectory, Hereford, who died suddenly on April 27th, 1938. Mr. Dansey maintained a regular rainfall record there since 1906 and took a great interest in meteorology, frequently forwarding details of his weather observations to the Office. Of his numerous contributions to this Magazine mention may be made of the following:—The Glacial Snow of Ben Nevis (1905, pp. 29–32); The extraordinary warmth of January, 1916 (1916, p. 8); June in the Pyrenees (1912, pp. 141–5); Corsica in May (1915, pp. 47–9); The Snowless winter of 1924–5 (1925, pp. 139–140); The hot summer

and Scottish snowbeds (1933, pp. 238 and 259) and Snow in June (1936, 159). Living near the Black Mountains of Breconshire, Mr. Dansey had opportunities of studying the incidence and distribution of snow, a subject in which he was keenly interested. His notes on the snow of the winter 1937–8 are included in this number (page 123).

We regret to learn of the death on June 6th, 1938 of Professor Dr. Hugo Hergesell, for many years Director of the Aeronautical Observatory, Lindenberg.

ERRATA

Climatological Tables, 1937

Lagos—July. Pressure diff. from normal *for* +1·7 *read* +0·9.
Mauritius—Jan. Rainfall diff. from normal *for* +1·96 *read* +2·36.
Mauritius—Feb. Rainfall diff. from normal *for* —2·42 *read* —3·31.
Singapore—March. Rainfall diff. from normal *for* —0·47 *read* + 0·47.
Sandakan—Feb. Rainfall diff. from normal *for* —6·39 *read* — 5·39.
Victoria, B.C.—Feb. Rainfall diff. from normal *for* +1·97 *read* — 1·97.

The Weather of May, 1938

The Azores anticyclone was well developed, and extended northward in a long ridge (above 1015 mb.) across Greenland to Spitsbergen. Pressure was 4 mb. above normal in the Azores and 6 mb. above in southern Greenland. There was a shallow depression (about 1012 mb.) from western Scotland across Scandinavia, but over most of Europe the distribution was remarkably uniform, about 1015 mb., and differed little from normal. The low pressure area over northern India was unusually vigorous, the means of 998 mb. being 4 to 5 mb. below normal. Pressure was also deficient (—5 mb.) in a depression over Alaska but elsewhere in North America it differed little from the average. Temperature was again above normal in the Arctic, by 3° F. in Spitsbergen, and by more than 5° F. in northwest Siberia but most of Europe south of 60° N. was several degrees colder than normal, the deficiency exceeding 5° F. in most of Italy and the Balkans. The British Isles differed little from normal except in the south-east (—2° F.). In northern India temperatures exceeded 90° F. and were 4° F. to 7° F. above normal, but western India and Burmah were cool (Mandalay —6° F.). In North America the differences were small. Rainfall was very variable; some heavy falls were recorded locally—nearly 8 inches at Marseilles and Venice, and 4 to 5 inches in parts of south-eastern Europe. In India the

rainfall was generally light except in the west (Rangoon 17 in., Calcutta 15 in., Mandalay 13 in.) where it was much above normal. North America differed little from average except for the Pacific coast, where rainfall was deficient.

Over the greater part of Australia pressure was slightly below normal, but south-east Australia and New Zealand showed an excess, reaching 5 mb. in the central regions of New Zealand. Temperature was generally slightly above normal and rainfall deficient, but heavy falls were experienced in some places (Adelaide 12 in., Norfolk Island 9 in.).

In contrast to the exceptional drought experienced in the three months February to April, rainfall in May was excessive over the British Isles as a whole. Sunshine was deficient generally in Ireland, England and the north-east of Scotland ; an excess was recorded, however, at numerous places elsewhere in Scotland and in parts of northern England. The month was cool in some districts, particularly the south and east of England.

During the opening days of the month an anticyclone moved slowly westward from the north-east of Scotland to the south of Iceland. Meanwhile pressure was relatively low over France and a depression off south-west Ireland moved south-east to Spain. Weather was fair and sunny in the north but rain fell locally at times in England and the extreme south of Ireland. Some good daily records of bright sunshine were registered during this period ; 14 hours or slightly more were registered at some place or other on each of the first five days and at Tiree, in the Inner Hebrides, the total for the four days 2nd–5th was 57·8 hours. On the other hand, at Croydon the total for the first four days was only 3·8 hours. Thereafter pressure was low over Scandinavia and high westward of the British Isles. Polar air caused a considerable fall of temperature on the 7th, and showers occurred, mainly in northern Scotland and on the east coast of Great Britain ; snow and hail were reported in Scotland on the 7th. On the 8th and 9th a depression south of Iceland moved east-south-east to southern Norway causing precipitation, chiefly in Scotland, the north of Ireland and north-east England. On the 10th a wedge of high pressure passed east over Great Britain. Subsequently pressure was high over central Europe, while Atlantic depressions moved north-east ; rain fell, chiefly in the west and north, and was somewhat heavy in places on the 11th and 13th ; 1·12 in. was measured at Waterford on the 13th. A period of unsettled weather ensued with depressions moving directly over the British Isles ; scattered thunderstorms occurred daily from the 14th–18th and fairly heavy rain was recorded locally ; for example, 1·54 in. at Edinburgh on the 15th, 1·65 in. at Barningham Park, Yorkshire on the 16th and 1·77 in. at Cranwell on the 17th, of which 0·95 in. fell in 48 minutes. It was warm generally on the 14th and temperature rose to 79° F. at Norwich and Herne Bay and 76° F. at Margate

and Tottenham. On the 19th and 20th a belt of high pressure moved eastward over the country; sunshine was good in many parts, but rain was recorded locally in eastern districts of England and in Ireland and the extreme south-west of England. A trough of low pressure moving north-east over the north-western districts of the British Isles gave rain in Scotland and Ireland on the 21st. Subsequently from the 23rd–31st, Atlantic depressions passed over the British Isles and unsettled weather prevailed. Rain fell frequently and local thunderstorms were recorded on the 24th, 27th, 28th and 30th. Among the heavier falls of rain in 24 hours were 1·59 in. at Montgomery on the 27th, 1·26 in. at Edinburgh on the 28th and 1·62 in. at St. Helens, Lancs., and 1·49 in. at Warrington on the 29th. Gales occurred locally in England from the 29th–31st.

The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ..	209	+30	Chester ..	168	+ 2
Aberdeen ..	147	−23	Ross-on-Wye	143	−43
Dublin	140	−40	Falmouth ..	168	−39
Birr Castle ..	147	−22	Gorleston ..	165	−58
Valentia ..	154	−30	Kew.. ..	161	−37

Kew, Temperature, Mean, 52·5°F, Diff. from average −2·0°F.

Miscellaneous notes on weather abroad from various sources.

Rain, accompanied by violent hailstorms, fell incessantly for 6 days in eastern Spain, until May 3rd. The drought in Switzerland which had lasted 70 days was broken on the 3rd. Heavy rain on the 8th caused flooding in parts of Lisbon. After a period of unseasonably cold, dry weather temperatures rose in Germany on the 15th, when 84·2°F. was recorded in Berlin; 10,000 acres of woodland between Bremen and Hanover were destroyed by fire on the same day. Heavy rain and the sudden thaw in the mountains caused the flooding of the River Mur on the 21st. Eleven people were drowned and over 300 rendered homeless in Syria and Carinthia. Intense cold swept over France and Switzerland on the 21st and 22nd, and snow fell down to the 1,500 ft. level. All the Alpine passes were blocked, but the Simplon was reopened on the 22nd. Thick fog was reported from Cherbourg on the 23rd. A breach in the Skeidarar Glacier in south-east Iceland on the 25th caused floods which interrupted all traffic and swept away telegraph wires. A cloudburst was reported from Budapest on the 29th. (*The Times*, May 4th–30th.)

A violent storm and a waterspout on the 4th destroyed 50 houses and caused 5 deaths in Antioch, Syria. (*The Times*, May 6th.)

The "long rains" broke throughout Kenya on the 6th, and continued with such force that floods occurred, interrupting railway

Rainfall : May, 1938 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square..........	1·43	81	*Leics* .	Thornton Reservoir ...	1·89	94
Sur .	Reigate, Wray Pk. Rd..	1·91	105	„ .	Belvoir Castle............	2·83	134
Kent .	Tenterden, Ashenden...	2·67	170	*Rut* .	Ridlington	1·87	93
„ .	Folkestone, Boro. San.	3·17	...	*Lincs* .	Boston, Skirbeck.........	2·06	117
„ .	Margate, Cliftonville....	1·81	115	„ .	Cranwell Aerodrome...	4·13	228
„ .	Eden'bdg., Falconhurst	2·65	142	„ .	Skegness, Marine Gdns.	2·36	139
Sus .	Compton, Compton Ho.	2·35	106	„ .	Louth, Westgate.........	2·03	100
„ .	Patching Farm..........	2·04	110	„ .	Brigg, Wrawby St.......	2·45	...
„ .	Eastbourne, Wil. Sq....	2·37	143	*Notts* .	Mansfield, Carr Bank...	2·92	138
Hants.	Ventnor, Roy.Nat.Hos.	1·29	76	*Derby*.	Derby, The Arboretum	1·72	86
„ .	Southampton,East Park	2·02	101	„ .	Buxton, Terrace Slopes	4·39	142
„ .	Ovington Rectory........	1·95	90	*Ches* .	Bidston Obsy.............	2·66	140
„ .	Sherborne St. John......	1·52	78	*Lancs*.	Manchester, Whit. Pk.	3·43	162
Herts .	Royston,Therfield Rec.	2·11	109	„ .	Stonyhurst College......	3·63	127
Bucks.	Slough, Upton............	1·81	108	„ .	Southport, Bedford Pk.	3·50	167
Oxf .	Oxford, Radcliffe.........	1·97	105	„ .	Ulverston, Poaka Beck	4·35	137
N'hant	Wellingboro, Swanspool	1·68	87	„ .	Lancaster, Greg Obsy.	3·47	140
„ .	Oundle	2·22	...	„ .	Blackpool	2·79	128
Beds .	Woburn, Exptl. Farm...	1·77	91	*Yorks*.	Wath-upon-Dearne......	2·50	123
Cam .	Cambridge, Bot. Gdns.	1·94	110	„ .	Wakefield,Clarence Pk.	2·87	146
„ .	March........................	1·97	114	„ .	Oughtershaw Hall.......	4·53	...
Essex .	Chelmsford,County Gdns	1·72	119	„ .	Wetherby, Ribston H..	...	...
„ .	Lexden Hill House......	1·42	...	„ .	Hull, Pearson Park......	3·17	164
Suff .	Haughley House.........	1·83	...	„ .	Holme-on-Spalding......	3·07	152
„ .	Rendlesham Hall........	2·27	150	„ .	Felixkirk, Mt. St. John.	3·47	185
„ .	Lowestoft Sec. School...	1·94	120	„ .	York, Museum Gdns....	3·35	168
„ .	Bury St. Ed., WestleyH.	2·07	114	„ .	Pickering, Houndgate...	2·99	153
Norf. .	Wells, Holkham Hall...	1·22	76	„ .	Scarborough...............	2·45	128
Wilts .	Porton, W.D. Exp'l. Stn	1·68	98	„ .	Middlesbrough............	2·97	155
„ .	Bishops Cannings........	1·85	95	„ .	Baldersdale, Hury Res.	4·11	159
Dor .	Weymouth, Westham.	1·13	70	*Durh* .	Ushaw College............	3·69	171
„ .	Beaminster, East St....	2·88	140	*Nor* .	Newcastle, Leazes Pk...	3·68	186
„ .	Shaftesbury,Abbey Ho.	1·95	92	„ .	Bellingham, Highgreen	3·05	127
Devon.	Plymouth, The Hoe....	3·05	147	„ .	Lilburn Tower Gdns....	2·38	103
„ .	Holne, Church Pk. Cott.	5·54	175	*Cumb*.	Carlisle, Scaleby Hall...	3·66	153
„ .	Teignmouth, Den Gdns.	2·34	128	„ .	Borrowdale, Seathwaite	11·75	170
„ .	Cullompton	2·52	117	„ .	Thirlmere, Dale Head H.	6·80	143
„ .	Sidmouth, U.D.C........	1·89	...	„ .	Keswick, High Hill......	3·83	120
„ .	Barnstaple, N. Dev.Ath	2·07	100	„ .	Ravenglass, The Grove	4·30	154
„ .	Dartm'r,Cranmere Pool	5·20	...	*West* .	Appleby, Castle Bank...	2·48	113
„ .	Okehampton, Uplands.	2·80	104	*Mon* .	Abergavenny, Larchf'd	2·22	83
Corn .	Redruth, Trewirgie......	3·39	147	*Glam* .	Ystalyfera, Wern Ho....	6·32	181
„ .	Penzance, Morrab Gdns.	2·84	129	„ .	Treherbert, Tynywaun.	7·88	...
„ .	St. Austell, Trevarna...	4·01	166	„ .	Cardiff, Penylan..........	3·21	131
Soms .	Chewton Mendip.........	2·41	87	*Carm* .	Carmarthen,M. & P. Sch.	4·87	171
„ .	Long Ashton.............	2·19	104	*Pemb* .	Pembroke,Stackpole Ct.	2·53	114
„ .	Street, Millfield...........	2·07	111	*Card* .	Aberystwyth	2·48	...
Glos .	Blockley	1·91	...	*Rad* .	BirmW.W.Tyrmynydd	4·83	141
„ .	Cirencester, Gwynfa....	2·54	123	*Mont* .	Newtown, Penarth Weir	...	...
Here .	Ross-on-Wye.............	1·88	88	„	Lake Vyrnwy	4·54	144
Salop .	Church Stretton.........	2·70	105	*Flint* .	Sealand Aerodrome......	2·37	129
„ .	Shifnal, Hatton Grange	1·32	64	*Mer* .	Blaenau Festiniog	6·02	116
„ .	Cheswardine Hall........	2·15	97	„	Dolgelley, Bontddu......	2·71	82
Worc .	Malvern, Free Library...	2·07	96	*Carn* .	Llandudno	1·94	109
„ .	Ombersley, Holt Lock.	1·48	72	„ .	Snowdon, L. Llydaw 9..	11·05	...
War .	Alcester, Ragley Hall...	2·12	103	*Ang* .	Holyhead, Salt Island...	2·48	127
„ .	Birminghm, Edgbaston	1·84	86	„ .	Lligwy	2·31	...

Rainfall : May, 1938 : Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
I. Man	Douglas, Boro' Cem.	5·08	203	*R&C* .	Achnashellach	3·80	85
Guern.	St.Peter P't.Grange Rd.	1·07	63	„ .	Stornoway,C.GuardStn.	2·85	117
Wig .	Pt. William, Monreith.	3·51	149	*Suth* .	Lairg	2·18	86
„ .	New Luce School	3·56	125	„ .	Skerray Borgie	4·27	...
Kirk .	Dalry, Glendarroch	4·81	153	„ .	Melvich	3·05	149
Dumf.	Dumfries, Crichton R.I.	4·22	163	„ .	Loch More, Achfary	4·27	97
„ .	Eskdalemuir Obs	6·19	188	*Caith* .	Wick	2·61	126
Roxb .	Hawick, Wolfelee	3·30	141	*Ork* .	Deerness	3·17	159
Peeb .	Stobo Castle	...	...	*Shet* .	Lerwick Observatory	4·26	204
Berw .	Marchmont House	2·90	117	*Cork* .	Cork, University Coll	4·48	198
E.Lot .	North Berwick Res	2·90	146	„ .	Roches Point, C.G. Stn.	4·18	172
Midl .	Edinburgh, Blackfd. H.	4·18	204	„ .	Mallow, Longueville	...	...
Lan .	Auchtyfardle	3·52	...	*Kerry*.	Valentia Observatory	5·02	158
Ayr .	Kilmarnock, Kay Park	3·79	...	„ .	Gearhameen	9·30	177
„ .	Girvan, Pinmore	2·93	98	„ .	Bally McElligott Rec	4·86	...
„ .	Glen Afton, Ayr San.	3·92	131	„ .	Darrynane Abbey	4·87	163
Renf .	Glasgow, Queen's Park	4·70	193	*Wat* .	Waterford, Gortmore	4·31	187
„ .	Greenock, Prospect H.	3·90	120	*Tip* .	Nenagh, Castle Lough.	3·29	133
Bute .	Rothesay, Ardencraig	4·63	153	„ .	Cashel, Ballinamona	3·96	168
„ .	Dougarie Lodge	4·19	152	*Lim* .	Foynes, Coolnanes	3·77	162
Arg .	Loch Sunart, G'dale	4·60	129	*Clare* .	Inagh, Mount Callan	5·03	...
„ .	Ardgour House	6·26	...	*Wexf* .	Gorey, Courtown Ho	2·68	121
„ .	Glen Etive	4·24	85	*Wick* .	Rathnew, Clonmannon.	2·54	...
„ .	Oban	3·54	...	*Carl* .	Bagnalstown,Fenagh H.	2·64	107
„ .	Poltalloch	3·69	128	„ .	Hacketstown Rectory	2·50	96
„ .	Inveraray Castle	7·32	186	*Leix* .	Blandsfort House	3·05	126
„ .	Islay, Eallabus	3·12	118	*Offaly*.	Birr Castle	3·63	163
„ .	Mull, Benmore	8·80	118	*Kild* .	Straffan House	2·91	132
„ .	Tiree	2·65	106	*Dublin*	Dublin, Phoenix Park	2·52	121
Kinr .	Loch Leven Sluice	4·52	185	„ .	Balbriggan, Ardgillan	...	...
Fife .	Leuchars Aerodrome	4·31	221	*Meath*.	Kells, Headfort	3·31	123
Perth .	Loch Dhu	5·00	111	*W.M* .	Moate, Coolatore	3·27	...
„ .	Crieff, Strathearn Hyd.	3·29	132	„ .	Mullingar, Belvedere	3·23	132
„ .	Blair Castle Gardens	2·80	138	*Long* .	Castle Forbes Gdns	3·56	138
Angus.	Kettins School	3·82	142	*Gal* .	Galway, Grammar Sch.	5·08	205
„ .	Pearsie House	4·14	...	„ .	Ballynahinch Castle	5·66	157
„ .	Montrose, Sunnyside	2·79	137	„ .	Ahascragh, Clonbrock	4·29	154
Aber .	Balmoral Castle Gdns	2·44	105	*Rosc* .	Strokestown, C'node	4·07	170
„ .	Logie Coldstone Sch	2·64	106	*Mayo*.	Blacksod Point	4·93	175
„ .	Aberdeen Observatory	2·59	111	„ .	Mallaranny	5·94	...
„ .	New Deer School House	3·18	146	„ .	Westport House	3·32	117
Moray	Gordon Castle	3·14	148	„ .	Delphi Lodge	8·63	143
„ .	Grantown-on-Spey	3·63	156	*Sligo* .	Markree Castle	3·88	139
Nairn.	Nairn	2·15	119	*Cavan*.	Crossdoney, Kevit Cas.	3·83	...
Inv's .	Ben Alder Lodge	3·02	...	*Ferm* .	Crom Castle	4·11	148
„ .	Kingussie, The Birches	2·22	...	*Arm* .	Armagh Obsy	3·87	163
„ .	Loch Ness, Foyers	2·78	114	*Down*.	Fofanny Reservoir	5·61	...
„ .	Inverness, Culduthel R.	2·08	112	„ .	Seaforde	2·32	88
„ .	Loch Quoich, Loan	5·37	...	„ .	Donaghadee, C. G. Stn.	2·31	102
„ .	Glenquoich	5·06	93	*Antr* .	Belfast,Queen's Univ	2·04	88
„ .	Arisaig House	4·40	128	„ .	Aldergrove Aerodrome	2·96	130
„ .	Glenleven, Corrour	...	...	„ .	Ballymena, Harryville	4·54	159
„ .	Fort William, Glasdrum	4·64	...	*Lon* .	Garvagh, Moneydig	2·85	...
„ .	Skye, Dunvegan	5·19	...	„ .	Londonderry, Creggan	2·83	108
„ .	Barra, Skallary	2·17	...	*Tyr* .	Omagh, Edenfel	3·71	143
R&C.	Tain, Ardlarach	2·59	115	*Don* .	Malin Head	2·38	97
„ .	Ullapool	2·70	106	„	Dunkineely	3·44	...

Climatological Table for the British Empire, December, 1937

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. ½ Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal.	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy....	1011·7	− 2·0	53	26	42·6	34·7	38·7	− 2·7	37·5	89	8·7	3·44	+ 1·15	17	0·8	10
Gibraltar	1018·5	− 1·8	68	42	58·8	49·4	54·1	− 1·9	48·8	77	5·5	7·83	...	12	...	...
Malta........	1014·4	− 1·8	70	43	60·3	51·3	55·8	− 2·1	50·4	73	7·2	4·77	+ 1·06	17	4·5	46
St. Helena	1011·9	− 1·4	67	56	63·8	57·4	60·6	− 0·3	58·5	95	10·0	2·09	+ 0·76	25	...	...
Freetown, Sierra Leone	1009·8	+ 0·6	89	69	86·6	75·0	80·8	...	76·6	81	4·7	2·14	+ 0·72	3	...	...
Lagos, Nigeria	1009·9	− 0·1	92	68	88·4	73·8	81·1	− 0·7	75·5	89	5·3	1·26	+ 0·45	5	6·9	59
Kaduna, Nigeria	1011·9	...	95	54	91·4	57·8	74·6	+ 1·3	56·3	53	2·6	0·00	0·00	0	9·4	82
Zomba, Nyasaland	1008·9	+ 0·4	91	60	81·0	66·1	73·5	+ 0·4	70·7	81	6·5	8·99	− 1·88	15	...	...
Salisbury, Rhodesia...	1010·1	− 0·4	87	54	78·8	59·8	69·3	+ 0·3	61·9	67	7·8	8·79	...	16	5·9	45
Cape Town	1014·2	− 0·1	92	54	79·7	60·5	70·1	+ 2·2	60·9	63	3·0	0·02	− 0·79	1	...	...
Johannesburg	1011·1	− 0·1	85	45	72·2	54·4	63·3	− 2·2	57·3	76	5·7	8·45	+ 3·02	24	6·7	49
Mauritius	1013·6	− 0·1	94	66	85·8	70·7	78·3	0·0	73·0	66	5·5	1·60	− 3·08	15	8·8	66
Calcutta, Alipore Obsy.	1014·0	− 1·7	83	50	77·1	56·8	66·9	+ 0·4	56·7	76	2·1	0·09	− 0·15	0*	...	...
Bombay	1012·0	− 1·5	90	64	84·1	68·0	76·1	− 1·3	65·3	68	3·1	0·00	− 0·05	0*	...	...
Madras	1012·6	− 0·9	84	59	81·2	67·2	74·2	− 2·5	69·0	80	4·7	7·25	+ 1·90	5*	...	...
Colombo, Ceylon	1010·9	+ 0·6	88	63	85·0	70·6	77·8	− 1·7	73·1	73	3·6	2·63	− 2·49	5	8·6	74
Singapore	1009·3	− 0·4	89	71	85·3	74·2	79·7	− 0·2	76·0	83	8·2	10·31	− 0·25	24	3·9	33
Hongkong........	1017·5	− 2·2	77	53	70·0	61·1	65·5	+ 2·5	59·6	70	6·8	0·61	− 0·42	4	5·4	50
Sandakan	1008·6	...	89	71	85·2	74·9	80·1	− 0·1	76·8	87	8·9	22·90	+ 4·26	22	...	...
Sydney, N.S.W........	1009·6	− 2·3	96	58	78·2	65·8	72·0	+ 1·9	66·0	66	7·1	2·49	− 0·37	14	7·7	53
Melbourne	1010·1	− 2·6	96	46	76·4	55·6	66·0	+ 1·2	58·9	60	7·7	1·42	− 0·85	15	6·4	43
Adelaide	1010·8	− 2·5	103	52	79·6	59·7	69·7	− 1·4	60·5	52	5·4	2·22	+ 1·19	6	8·0	56
Perth, W. Australia ...	1012·7	− 0·5	93	52	79·1	60·0	69·5	− 1·3	59·5	46	3·8	0·17	− 0·39	5	11·4	80
Coolgardie	1009·8	− 1·4	106	51	88·0	60·0	74·0	− 1·7	61·4	49	2·7	0·11	− 0·58	1	...	...
Brisbane........	1010·5	− 1·5	94	63	84·8	68·0	76·4	0·0	69·9	65	6·0	4·53	− 0·36	14	9·3	67
Hobart, Tasmania......	1009·7	0·0	83	43	67·3	52·0	59·7	− 0·5	53·4	61	8·3	2·56	+ 0·57	18	5·7	37
Wellington, N.Z.	1014·0	+ 1·8	76	49	68·4	55·0	61·7	+ 1·5	59·0	76	7·2	3·18	− 0·04	12	7·3	48
Suva, Fiji	1009·7	+ 1·1	89	71	84·8	74·0	79·4	+ 0·4	74·5	78	6·9	5·51	− 7·01	20	5·9	45
Apia, Samoa	1008·1	− 0·2	88		85·5	74·5	80·0	+ 0·7	75·9	76	6·1	11·17	− 2·72	21	6·2	48
Kingston, Jamaica	1012·7	− 1·3	89	3	85·7	69·7	77·7	0·0	68·0	86	5·4	0·58	− 1·01	5	...	...
Grenada, W.I.	1010·3	− 1·5	88	1	86	73	79·5	+ 1·3	73	74	6	10·85	+ 3·65	22	...	...
Toronto........	1019·2	+ 1·6	43	2	33·0	21·9	27·5	+ 0·4	...	...	6·8	0·76	− 1·71	4	2·4	27
Winnipeg	1020·5	+ 1·8	38	−25	14·5	−3·4	5·5	− 0·3	...	...	5·7	0·00	− 0·94	0	2·1	26
St. John, N.B.	1016·7	+ 2·7	49	−5	30·8	17·6	24·2	− 0·2	20·7	80	6·2	1·91	− 2·26	7	3·3	37
Victoria, B.C........	1016·1	− 0·6	52	27	46·3	38·6	42·5	+ 1·4	40·9	90	8·4	6·94	+ 1·20	22	2·0	24

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

Climatological Table for the British Empire, Year 1937

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. $\frac{1}{2}$ Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal.	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy....	1012·8	− 2·6	85	25	57·3	44·8	51·0	+ 0·8	46·1	87	7·7	29·67	+ 5·87	164	3·7	28
Gibraltar..........	1017·1	− 0·8	92	42	67·2	57·9	62·5	− 1·7	57·3	83	5·1	34·54	...	92	...	...
Malta..........	1015·3	0·0	95	43	71·2	61·3	66·2	+ 0·1	61·0	75	4·5	16·69	− 3·17	65	8·2	66
†St. Helena..........	1013·5	− 1·0	75	52	65·0	58·3	61·6	+ 0·9	59·2	94	9·5	35·51	+ 5·49	212	...	...
Freetown, Sierra Leone	1011·5	+ 1·7	93	68	85·7	74·2	80·0	...	75·6	81	5·8	149·87	− 7·36	175	...	...
Lagos, Nigeria	1011·5	+ 0·6	94	68	86·3	75·5	80·9	+ 0·2	75·7	87	7·2	81·81	+ 9·83	121	6·1	50
Kaduna, Nigeria	1011·6	...	101	50	89·4	65·3	77·4	+ 0·9	65·4	69	5·4	44·93	− 8·90	98	7·8	65
Zomba, Nyasaland	1012·0	− 0·3	95	46	78·9	60·7	69·8	+ 0·4	65·9	78	5·3	48·43	− 6·11	92	...	...
Salisbury, Rhodesia...	1014·1	− 0·5	95	36	77·5	53·5	65·5	+ 0·2	56·5	57	3·7	28·17	...	81	8·0	67
Cape Town	1017·3	+ 0·3	98	38	72·1	54·8	63·4	+ 1·1	56·0	78	4·4	28·04	+ 3·00	110	...	...
Johannesburg	1015·3	+ 0·1	90	23	71·0	49·9	60·5	+ 0·7	50·5	56	3·0	32·27	− 0·95	98	8·6	72
Mauritius	1015·4	− 0·7	94	53	80·6	67·9	74·3	+ 0·3	70·7	75	5·6	54·78	+ 5·03	213	7·9	65
Calcutta, Alipore Obsy.	1007·1	− 0·5	106	49	87·4	71·3	79·3	+ 0·7	71·9	84	5·2	75·41	+ 11·09	83*	...	...
Bombay	1008·5	− 0·7	94	61	86·3	73·9	80·1	− 0·5	72·9	78	4·5	70·72	− 1·47	84*	...	...
Madras	1008·1	− 0·7	106	59	90·0	75·4	82·7	− 0·4	75·0	75	6·3	61·38	+ 11·82	63*	...	...
Colombo, Ceylon	1009·8	+ 0·1	90	63	85·8	75·3	80·6	− 0·5	76·6	77	6·4	103·81	+ 23·68	184	7·2	60
Singapore	1009·3	− 0·2	93	70	86·1	76·1	81·1	+ 0·2	77·3	80	7·1	89·19	− 5·93	192	5·8	48
Hongkong..........	1011·8	− 0·7	93	46	78·1	69·7	73·9	+ 1·7	69·0	78	7·2	82·51	− 3·22	144	5·2	43
Sandakan	1009·0	...	92	71	88·1	75·5	81·8	+ 0·5	77·3	84	7·8	122·14	− 2·65	191	...	...
Sydney, N.S.W..........	1016·2	+ 0·3	98	41	70·9	57·0	63·9	+ 0·8	58·0	68	6·2	52·00	+ 4·52	157	6·5	54
Melbourne	1016·7	+ 0·4	99	30	68·1	49·7	58·9	+ 0·5	52·7	69	6·6	21·45	− 4·02	144	5·4	44
Adelaide	1017·5	+ 0·4	106	38	72·7	53·9	63·3	+ 0·3	55·5	59	6·2	23·01	+ 1·86	128	6·3	52
Perth, W. Australia ...	1017·1	+ 0·7	108	36	74·0	55·8	64·9	+ 0·7	57·0	61	4·7	35·28	+ 0·91	118	8·3	68
Coolgardie	1016·0	+ 0·1	110	30	76·6	52·1	64·4	− 0·2	55·3	60	3·4	11·18	+ 0·91	46	...	...
Brisbane..........	1016·0	+ 0·1	101	42	77·8	60·2	69·0	+ 0·1	62·2	65	4·6	34·79	− 10·50	113	7·7	63
Hobart, Tasmania..........	1014·9	+ 2·4	98	30	61·5	47·1	54·3	− 0·1	48·6	66	6·2	20·65	− 3·14	160	5·7	47
Wellington, N.Z.	1015·3	+ 0·7	76	33	59·5	47·7	53·6	− 1·7	50·8	77	7·1	34·15	− 13·89	159	5·7	46
Suva, Fiji	1011·6	+ 0·3	94	63	83·3	73·1	78·2	+ 1·2	73·6	82	6·8	106·63	− 10·51	260	5·2	43
Apia, Samoa	1010·0	− 0·3	90	69	85·2	74·4	79·8	+ 1·3	76·1	77	5·5	110·87	+ 1·16	203	7·0	58
Kingston, Jamaica	1012·9	− 0·8	94	63	87·1	71·8	79·4	+ 0·1	70·3	82	3·3	28·10	− 5·49	79	...	...
Grenada, W.I.	1011·1	− 1·2	90	70	86	73	79·5	+ 0·6	73	74	...	76·49	+ 1·90	234	...	...
Toronto..........	1016·3	− 0·3	95	2	54·9	40·3	47·6	+ 2·4	...	...	6·0	31·92	+ 0·63	131	5·4	42
Winnipeg	1016·4	+ 0·2	97	−37	45·2	25·5	35·4	+ 0·8	...	...	5·5	18·05	− 2·13	115	5·4	42
St. John, N.B.	1015·1	+ 0·5	87	− 5	51·5	36·1	43·8	+ 2·7	39·5	79	6·6	39·57	− 8·51	159	5·4	43
Victoria, B.C..........	1015·9	− 0·7	88	19	55·4	43·7	49·6	+ 0·2	46·3	83	6·8	30·43	+ 0·12	161	5·4	42

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen. For corrections to 1937 tables see *Errata* p. 129

† N.B.—Height redetermined. Pressure values from 1925 to 1937 should be corrected by +3·7 mb.

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traffic between Nairobi and Mombasa on the 25th and rendering the Mombasa aerodrome unusable. Fourteen inches of rain were recorded in 3 days in Mombasa. (*The Times*, May 7th–27th.)

The most widespread drought since 1902 in New South Wales was broken when heavy rains began to fall on the 24th. Anxiety for crops has been relieved as the rain has been accompanied by unusually mild weather. (*The Times*, May 25th–28th.)

The steamer *Mandalay* was sunk after a collision in heavy fog in lower New York Bay on the 29th. (*The Times*, May 30th.)

Daily Readings at Kew Observatory, May, 1938

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	Remarks
	mb.		°F.	°F.	%	in.	hrs.	
1	1014·4	NNE.5	45	52	65	0·01	0·6	pr_0 1h., 12h. and 14h.
2	13·9	E.4	43	53	69	Trace	0·2	id_0 6h.–10h., r_0 17h.
3	15·8	NE.4	45	49	77	0·28	0·0	r_0–r 7h.–15h., r_0 23h.
4	17·7	ENE.5	48	57	53	—	5·1	
5	18·7	ENE.4	43	60	39	—	13·6	
6	18·8	NE.3	43	60	52	—	9·7	
7	18·3	NNE.4	40	53	51	—	3·3	x early.
8	23·2	WNW.1	31	55	44	—	10·4	x early.
9	17·4	SW.3	34	58	41	—	3·3	x early.
10	20·7	WNW.1	39	61	50	—	4·3	x early.
11	24·8	S.3	45	65	40	—	12·1	
12	20·1	SSW.4	40	67	43	0·01	10·8	ir_0 19h.–22h.
13	17·5	SSW.4	52	65	63	Trace	1·4	pr_0 10h.
14	07·7	SE.2	50	75	47	0·02	3·6	ir_0 15h. and 18h.–23h.
15	09·6	S.4	55	67	58	0·02	8·2	r_0–r 2h.–3h.
16	14·0	S.4	52	62	76	Trace	1·3	pr_0 8h. and 9h.
17	12·0	SE.2	47	60	80	0·09	0·0	ir_0 11h.–15h., r 18h.
18	07·5	NW.3	46	58	56	0·03	1·0	r_0–r 19h.–23h.
19	16·1	NW.3	42	55	50	—	3·7	
20	19·1	NE.3	40	57	57	Trace	9·6	pr_0 12h.
21	24·5	NNE.4	40	61	44	—	14·1	x early.
22	25·1	NNW.3	41	69	55	—	10·4	
23	16·5	SW.4	46	70	54	—	6·4	w early.
24	16·1	NW.4	45	61	50	0·02	5·9	pr 9h. and 13h.
25	13·4	SW.2	49	57	78	0·13	0·4	ir_0–r 8h.–16h.
26	09·0	S.4	43	62	59	—	3·9	fe till 8h.
27	00·5	SSW.2	51	65	74	Trace	1·3	pr_0 11h., 12h. and 13h.
28	01·7	WNW.3	51	55	87	0·48	0·8	r_0–r 7h.–13h., 17h.–22h.
29	07·3	SSW.4	45	60	59	0·07	6·4	ir_0–r 16h.–21h.
30	01·7	W.4	48	61	64	0·05	8·2	pr_0 7h.–13h., t 14h.
31	1010·8	S.5	45	59	77	0·09	1·4	d_0 13h., r_0 19h.–22h.
*	1014·6	—	45	60	58	1·30	5·2	*Means or totals.

General Rainfall for May, 1938

England and Wales	124	per cent of the average 1881–1915.
Scotland	136	
Ireland	139	
British Isles ...	130	

(42477) Wt. 21/31 1,125 6/38 Hw. G.377/6

Frontispiece.

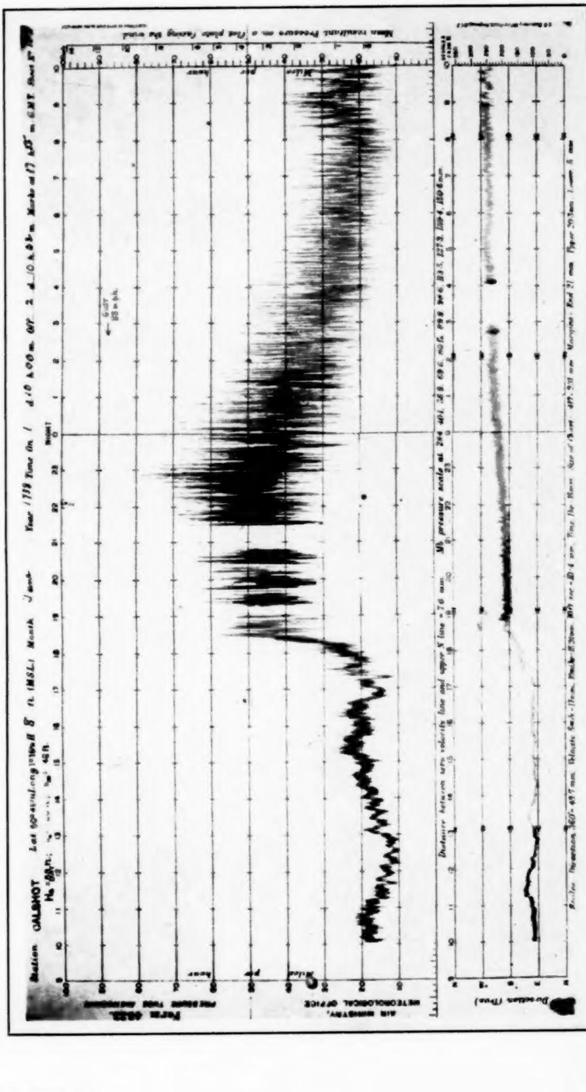

FIG. 1.—CALSHOT ANEMOGRAM, JUNE 1ST–2ND, 1938.